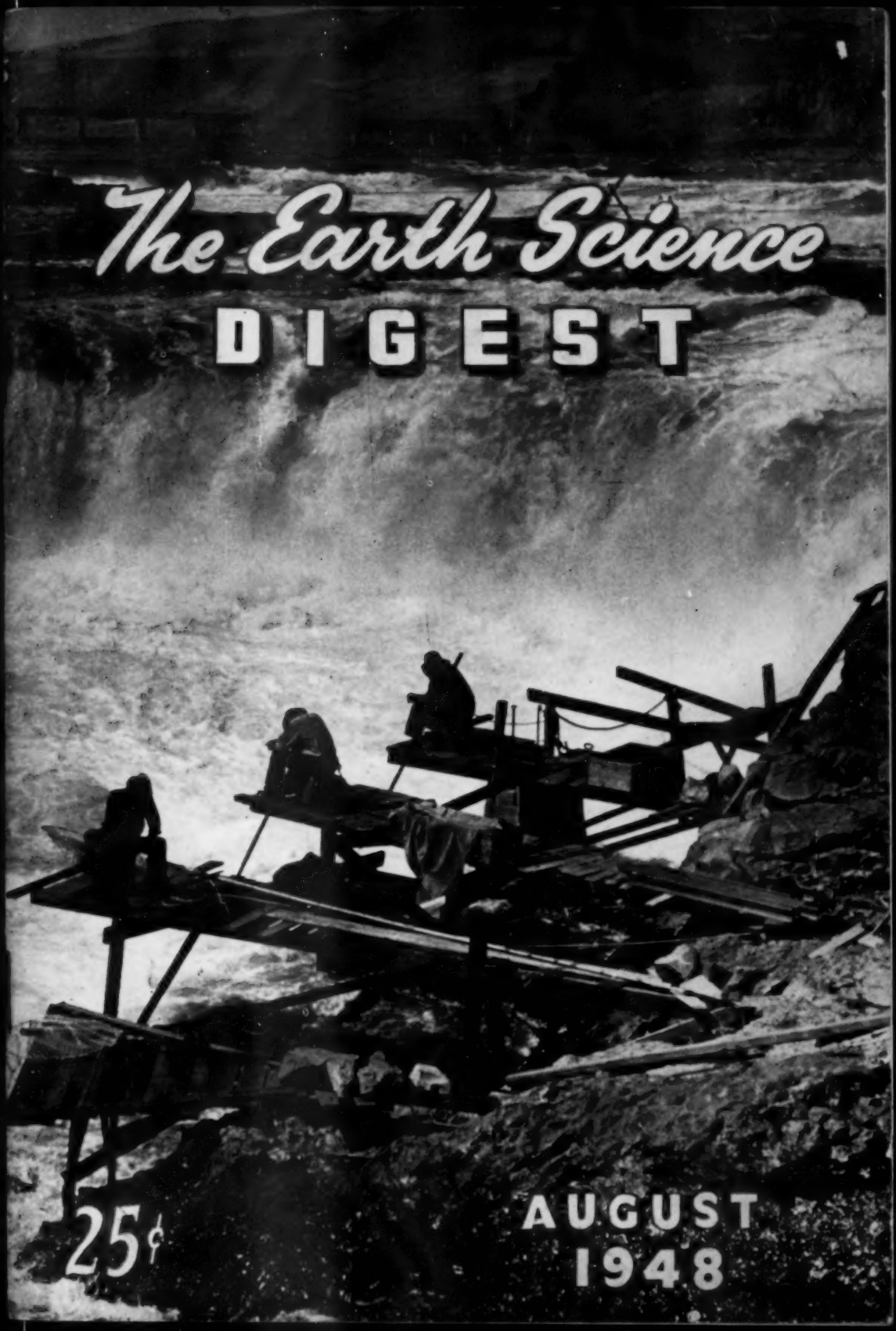
The Earth Science
DIGEST
25¢
AUGUST
1948

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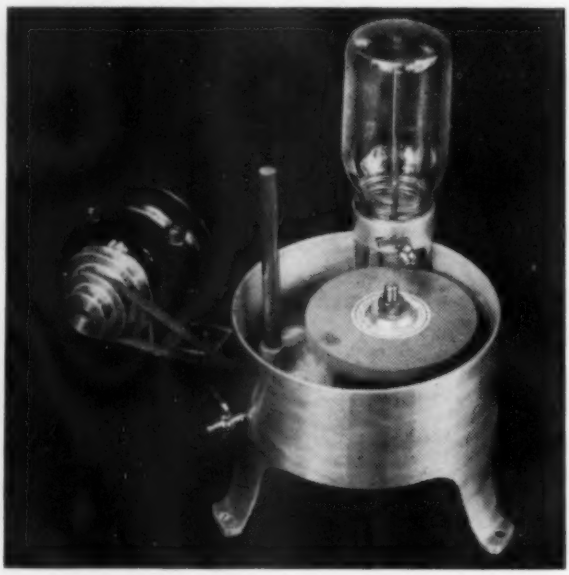

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The Earth Science Digest

Revere, Massachusetts

A magazine devoted to the advancement of the geological sciences.

THE EARTH SCIENCE DIGEST is open to articles of geologic interest. Manuscripts, photographs and sketches will be returned if accompanied by ample first-class postage.

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S. Albert Eisenberg, Publisher
Gertrude Roberts, Business Manager

Vol. III AUGUST - 1948 No. I

Contents

DR. WILSON APPOINTED TO EDITORIAL BOARD

We are pleased to announce the recent appointment to our editorial board of Dr. Ben Hur Wilson, one of America's foremost leaders in geologic education.

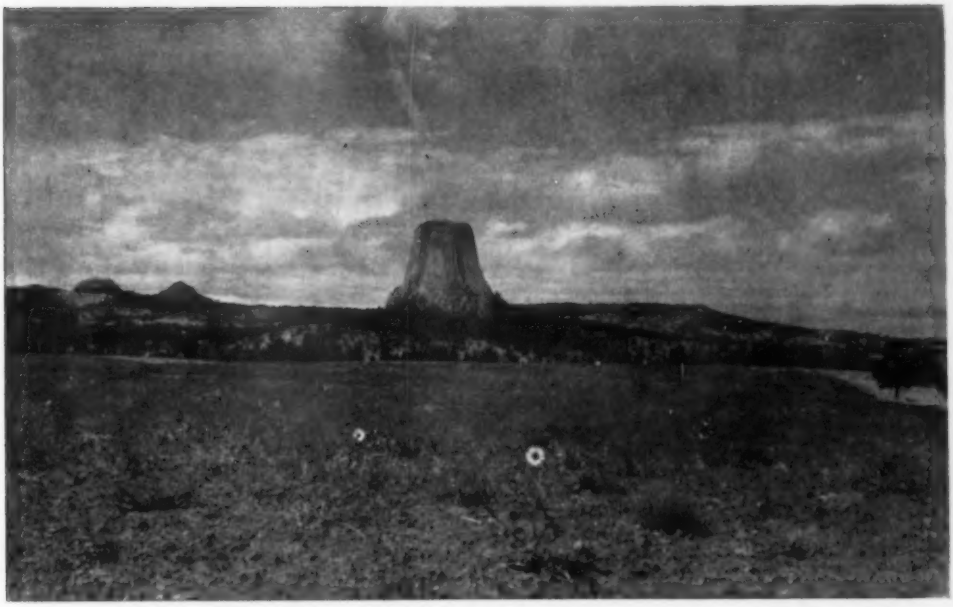
Dr. Wilson was the founder of the Midwest Federation of Geological Societies, and co-founder of the American Federation of Mineralogical Societies, having served as first president of both organizations. He is the author of numerous articles on geological subjects, and is co-author of the book **Quartz Family Minerals.**

COVER PHOTO

This month's cover photo, by H. P. Zuidema, is of the Columbia River, at Celilo Falls, near Dillon, Oregon, where the Indian fishermen net the migrating salmon. The river crosses one of the greatest lava plateaus of the earth. Successive flows, reaching great thickness, cover approximately 200,000 square miles of the Pacific northwest.

THE TOURING PUBLIC DISCOVERS MATO TIPI

H. P. ZUIDEMA
University of Michigan



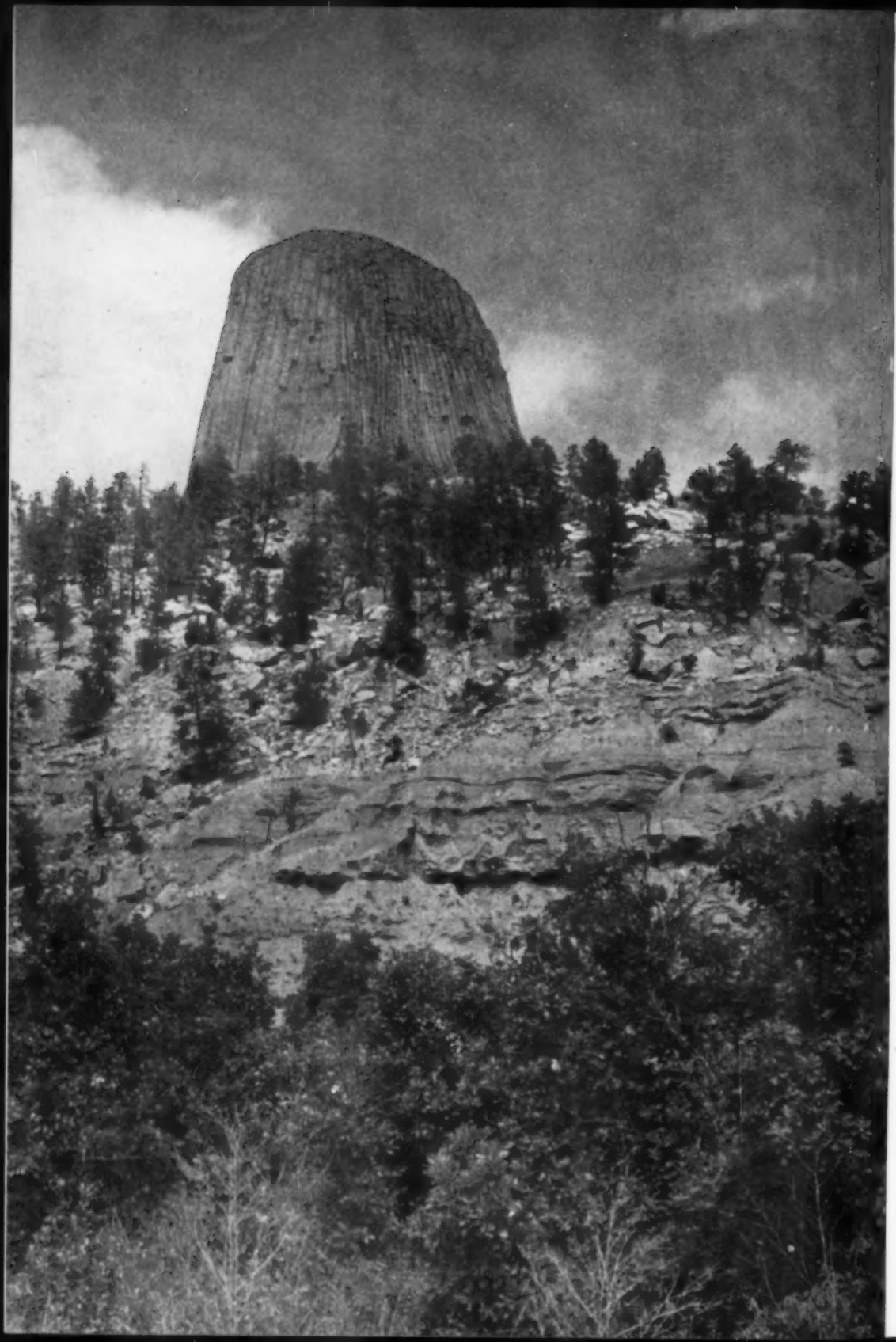
Devil's Tower, near the Black Hills. This "yardstick of erosion" is a great mass of phonolite porphyry associated with the Missouri Buttes, seen on the horizon to the left.
—Photo by H. P. Zuidema

A great number of Americans displayed no impelling interest in the alluring natural attractions of the Black Hills until someone began to chisel faces in a cliff on Mt. Rushmore. And inasmuch as Sculptor Borglum's work is only a small part of the grand picture presented by South Dakota's mountain region, thousands of the visitors who first came to see the stone faces are returning to contemplate those wonders of the Hills (and they are many) which are not of Man's making.

Similarly, the intervention of a foolhardy parachutist served to introduce the hurrying tourist to another of the spectacular sights of the West—Devil's Tower.

When publicity-seeking George Hopkins floated down from an airplane and landed on the aged crest of Mato Tipi, or Bear Lodge, as the Dakota Indians called the Tower, he gave this lofty stone pedestal in the northeastern corner of Wyoming, just across the Dakota line, the popularity it had long merited.

You may have long forgotten the name of the parachutist, George Hopkins, for such is his sort of fame, but once you have looked skyward from the base of Devil's Tower, everything else in your consciousness is dwarfed, and remains so. The Tower becomes a measuring stick of stark hugeness, and nothing ever seems as big to you again.



A geologist, visiting "Mato Tipi" during a mountain shower, inspects one of the great pillars which fell from the tower possibly centuries ago. Note the hexagonal cross section of the pillar.

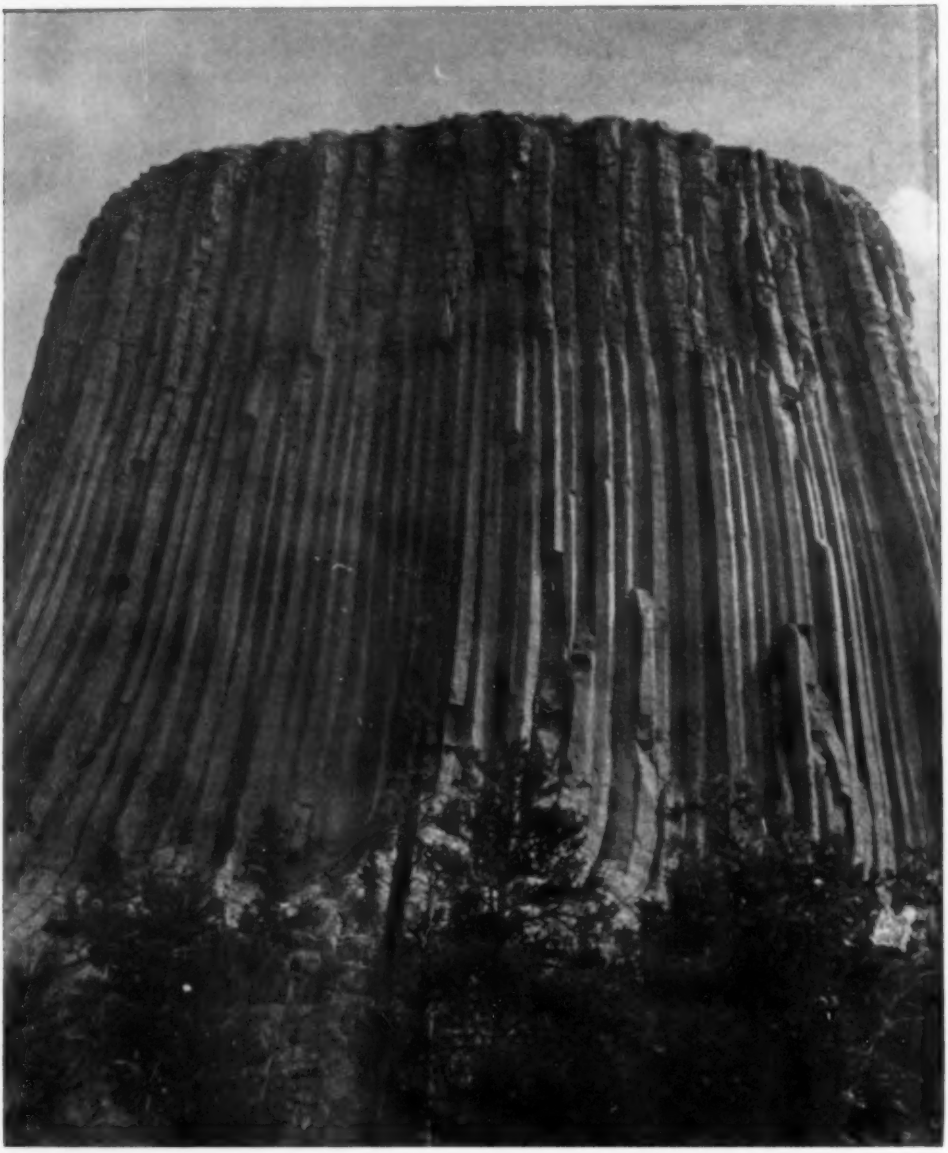
After the traveler swings off the main road from the Black Hills to the Big Horns and the Yellowstone and drives along the Tower loop, he sees a mass against the horizon which shouldn't be there. It doesn't fit, but it is not a mirage. It is the first view of Devil's Tower.

At a distance of 12 miles, it strikes one as rather large. At seven miles it is huge. At two miles it stands unreal and awesome, and as you stand at its base, it floors you. The top is 1,280 feet above the Belle Fourche River, or as high as the Empire State Building. The visible base of Devil's Tower, from which great columns of rock rise perpendicularly to the heavens, is more than 600 feet above the river, because the river has cut a valley close to the Tower, so the actual height of the Tower measured from its broad base is still somewhat more than 600 feet.

Its walls appear to be unscalable by man, although it has been climbed, and hence Mr. Hopkins found himself in a rather uncomfortable position until the National Park Service could summon professional mountain climbers from Colorado to bring him down.

Standing where the Park Service camp grounds now are, the Dakota Indians were reverent in the sight of the Tower, for here the Great Spirit, so they told, raised the mighty rock directly out of the earth, with a young Indian and his

The Devil's Tower as seen from the Belle Fourche River, which flows 1200 feet below the top of the great natural pillar.
Photo by H. P. Zuidema



Contraction of the rock as it cooled formed the great columns, several feet in diameter, which make up the Devil's Tower.

—Photo by H. P. Zuidema

maiden upon it, so that the Great Bear, the monster which had pursued them, could not devour them.

The great grooves that reach from top to bottom are the scratches of the monster's claws as he tried without success to reach the pair. We have another explanation for the Tower now. The geologist finds that the Tower is a mass of intrusive rock which rose as molten material through the sedi-

mentary rocks of the area and which, on cooling, contracted to form great vertical prisms which are four, five and six-sided. Faces of adjacent prisms form the grooves on the sides of the Tower. Phenocrysts of feldspar were formed in the rock as it cooled, hence the rock is called a porphyry.

The great columns, 600 feet long, have a total thickness of a third of a mile at the gently fluted base and the mass tapers off gradually toward the top, which is still some 300 feet in diameter. At the base of the Tower lie thousands of tons of broken columns, felled by the weathering processes through the ages, yet not one of the settlers in the area can recall the falling of a single column in his time, so slowly operated the processes which create and destroy, raise and level the features on the face of our earth.

Today there remains enough rock in the Tower, if we are to accept the word of a mathematically-inclined park service naturalist, to surface a 16-foot highway which would circle the earth nine times.

The Tower is eloquent proof of the vast amount of sedimentary rock which has been stripped from the area by erosion since the time when the rock of the Tower rose from the depths some dozens of millions of years ago. The height of the Tower, plus the unknown distance the great stone spire once extended upwards, represents the depth to which the mass was once buried in protecting strata in which it solidified. This strata was less resistant to the forces of erosion and was carried away, leaving the Tower as a solitary monument and landmark.

When one looks up from the base and gazes skyward, one marvels that at least 40 persons have reached the summit and lived to climb down again. Iron pegs, driven into the rock by skilled alpinists, made the climb possible for most of these, but today the pegs have weathered out or have been removed to discourage novices, this circumstance accounting for the difficulties attendant upon the rescue of the parachutist.

Among the early climbers (few have gone up in recent decades) was a man by the name of Will Rogers—not the humorist. Spectators at a Fourth of July picnic of local people were cheering his achievement as he approached the top when small voices were heard from the summit. The startled crowd looked again and saw the source of the cries—two twelve-year-olds, who were having their moment of fame before their dangerous descent and inevitable spanking.

But man's exploits, foolhardy, adventurous, cannot detract from the grandeur of Devil's Tower. Long before the first man came on earth, Mato Tipi stood, little altered, already old, above the countryside. And it will crown the Wyoming hill country, still defiant against the elements, ages, perhaps, after **Homo sapiens** bows his way out of the scene of things.

The Earth Sciences — 1948

by Science Service

MORE OIL FROM PETROLEUM WELLS HOPED BY MIXING OIL AND WATER UNDER PRESSURE

CAMBRIDGE, Mass., July 2 — More oil from so-called exhausted petroleum wells is hoped to result from research on the mixing of oil and water under high pressure, the American Chemical Society was told here by Prof. Ernst A. Hauser and A. S. Michaels of the Massachusetts Institute of Technology.

Secondary production of oil from wells from which the freer-flowing crude has been removed by pumping is always important but particularly so now with decreasing reserves and the increasing demands for petroleum products. Primary pumping takes from the oil-bearing sands about one-third of the crude they ho'd, it is estimated.

Another third can be recovered by various pressuring methods. In these, water,air, or natural gas taken from the oil are pumped down central wells to help the flow of the oil to the out-take wells. There are other methods also employed, but the amount still unrecovered is still too great.

The term underground oil pools, often used, is misleading. The crude underground is largely held in the pores of rocks and sand. The movement of the oil from locations away from the well to replace the crude which the pumps have removed is slow. Pressure behind it helps, but there is still much held in or clinging to the tiny pores of the sandstone that repels the water used in pressurizing. A way is now sought to reduce this repulsion. This would make it possible to displace and recover more oil from either abandoned or existing wells.

In the study reported here, a new machine, called a high pressure tensiometer, is being used. It enables scientists to measure the mixing of oil and water at pressures and temperatures as great as those encountered in deep oil wells.

The tensiometer is a heavy stainless steel box with thick glass windows which is filled with water in which a drop of oil is suspended from the tip of a thin metal rod. The temperature of the contents can be raised up to 350 degrees Fahrenheit while pressures up to 10,000 pounds per square inch are applied. The mutual repulsion of the two liquids is calculated from the shape of the oil drop, the changes of which are recorded with an microscopic camera.

FOUR EARTHQUAKES IN THREE DAYS RECORDED; JAP ONE MOST DAMAGING

WASHINGTON, July 2—Four separate earthquakes in three days were recorded in the last days of June.

The quakes began Sunday (June 27) with shocks south of the Alaska peninsula and under the Gulf of Mexico off the Guatemalan coast. A disastrous shock struck Japan Monday and the region of the Samoan Islands was shaken the following day.

Scientists say that there is no evidence that such widely separated quakes are related in any way.

Although thousands of persons were killed and injured in the destructive Japanese quake, the one in Samoa was rated as just as strong a shock. The difference was that the former rocked a thickly populated area. Both were rated 7.25 on the seismologists' scale of magnitude.

Epicenter of the Jap quake was not on land, as had at first been suggested, but under Wakasa Bay, some 35 miles west of the ruined city of Fukui.

SMALL CARVING FOUND IN MEXICO BELIEVED 20,000 YEARS OLD

SANTA FE, N. M., July 8— Were there native American artists in Mexico 20,000 years ago, at the same time that Cro-Magnon masters were frescoing the walls of caves in France and Spain, and carving images of ivory and reindeer horn?

First bit of evidence that such may have been the case was laid before the Archaeological Society of New Mexico here by Dr. Hellmut de Terra of the

Viking Fund, in the shape of a miniature sculpture which he found at Totolizingo in the Valley of Mexico. The find was made in the sand of what had once been a lake beach in the last centuries of the Pleistocene ice age. The geologic date is set by fossils of extinct species of horse, elephant and deer dug up at the same level. Further evidence of human occupation of this beach was indicated by three small bone points found by Dr. de Terra.

This small carving, the discoverer pointed out, apparently indicates the existence of a prehistoric race on this continent with an age at least double the 10,000 years estimated for Tepexpan Man, who since his discovery in February, 1947, has been considered America's oldest inhabitant.

SECOND TEST OF GETTING COMBUSTIBLE GASES BY BURNING UNDERGROUND COAL IS STARTED

GORGAS, Ala., July 9—A second experiment is underway here, following that of last summer, to produce combustible gases by burning unmined coal deep underground as it lies in its natural seams. A contract to carry out the work has been made by the U. S. Bureau of Mines and the Alabama Power Company, the team that carried out the first experiment a year ago.

Basically, the plan followed consists of drilling from the surface down through the layer of coal. Fire is started by dropping an incendiary bomb down a hole. Air, under considerable pressure, is forced down the same hole to feed the fire and to force the combustible gases formed by the burning through the coal layer to one or more of the other drillings. The gases arising to the surface are captured and piped to storage tanks. They can be used to fire a boiler or used to make synthetic liquid fuels.

The experiment last summer showed that gases produced by burning unmined coal offer a potential source of fuel for power and raw materials for synthetic liquid fuels. If the plan proves commercially feasible, much coal can be utilized that is in layers too thin for economical mining. The gas obtained is a cheap source of carbon monoxide and hydrogen, the number one problem in making the manufacture of synthetic liquid fuels economical.

Last year's experiment showed that the underground combustion can be maintained and controlled, that coal in place can be gasified completely, and that the roof rock settles behind the burning face without cutting off the air or gas. But the gas obtained was of lower heating value than desired, probably because of leakages of gas and air pressure through cracks and breaks in the 30-foot layer of earth over the burning coal.

This year a 40-inch seam approximately 100 feet below the surface is to be used. Higher air pressure and higher temperature will be employed. Oxygen and steam can improve the gas quality further, as was proven last year.

NEW BIRD MIGRATION THEORY CITES CONTINENTAL DRIFT

EVANSTON, Ill., July 15 — Birds make their long flights between summer nesting areas and winter feeding grounds, often crossing oceans to do so, because these summer and winter homes, once close together, have through millions of years drifted slowly apart. This is the somewhat startling theory of bird migration proposed by Dr. Albert Wolfson of Northwestern University.

Dr. Wolfson starts with the concept of continental drift, familiar to all geologists though still looked upon skeptically by some of them. According to this idea, there were once just two great land masses on earth. North America and Eurasia were combined in the northern mass, called Laurasia; South America, Africa and Australia in the southern one, which has been named Gondwana.

Near the end of the Age of Reptiles, roughly a hundred million years ago, Laurasia cracked into two parts and Gondwana into three, drifting very slowly apart as their lighter rocks floated in the earth's crust, which is not rigid but very stiffly viscous, like exceedingly cold molasses.

By that time birds had evolved from their reptilian ancestry, and were presumably making short migration flights between breeding and feeding areas. As the separation became wider and wider the flights had to be longer and longer; week-winged birds fell and were drowned, and only the strong survived.

Dr. Wolfson presents details of his theory in the journal, Science, with maps of some of the extraordinary flight routes used.

GIANT QUARRY BLAST IN TENNESSEE REGISTERS ON ST. LOUIS SEISMOGRAPHS

ST. LOUIS, July 18—Seismographs at St. Louis University here registered the earth-shock caused by the explosion of 42 tons of high explosive in the north-

eastern corner of Tennessee on Wednesday afternoon (July 14). The big shot, one of the greatest quarry blasts ever fired, was set off at 2:03 p.m., EST, and the instruments show that its tremors passed under St. Louis seven minutes and thirteen seconds later.

The super-blast loosened more than a half-billion cubic yards of rock at the site of TVA's South Holston Dam, near Bristol, Tenn.

TEAPOT MADE OF DIAMONDS PROPOSED BY SCIENTIST

WASHINGTON, July 22—If you want a better teapot and other cooking vessels, make them of diamonds. This is the advice Sir Chandrasekhara Venkata Raman of the Indian Institute of Science, Bangalore, India.

"If diamonds became cheap enough and you could make a nice teapot from them, it would be better than Pyrex glass because diamonds conduct heat better," explains Dr. Ramon, who won a Nobel prize in 1930 for his discovery of the Raman effect in the scattering of light.

The Indian scientist is in this country to attend a meeting of the Advisory Council of the International Bank of Reconstruction here and the first International Congress of Crystallographers at Harvard University where he will report his latest researches on diamonds.

He suggests that diamonds "would be an ideal substitute for cooking vessels."

And sometime in the future, perhaps in a thousand years, he believes man may be able to make synthetic diamonds. When this is done, the diamond teapot may become practical.

ALL HELIUM IN METEORITES DUE TO COSMIC RADIATION

ANN ARBOR, Mich., July 26.—All of the helium found in any meteorite was produced by cosmic radiation, Dr. Carl A. Bauer of the University of Michigan here calculates.

Cosmic radiation has acted on all meteorites for the same amount of time —ever since the disruption of the parent planet to which these meteorites originally belonged—Dr. Bauer states. The proportion of a meteorite's mass lost in traversing the earth's atmosphere has little effect on the helium content, he reports in the current Physical Review.

It was Dr. Bauer who last fall announced that iron meteorites arriving from outer space are not seven billion years old, as previously estimated, but only about half that age.

At that time he pointed out that meteorites could be "artificially aged," extremely small amounts of helium gas contained in the bits of heavenly iron resulting from intense cosmic-day bombardment in outer space. Heretofore it has been assumed that the helium was due to radioactive breakdown of uranium and thorium, the iron fragments having been in existence long enough as solids to allow the helium gas in them to be formed that way.

If cosmic radiation produced helium in small meteorites, the University of Michigan scientist reasons, then this process is sufficient to produce, in the same period of time, all the helium observed in any meteorite.

BLOOD FLOWED 100,000 YEARS AGO WHERE ARABS AND JEWS FIGHT TODAY

WASHINGTON, July 26—Bloodshed in the tension-zone between the Holy Land and Egypt is no new thing under the sun. Ages before the present fighting, even before the Children of Israel saw the pursuing chariots of Pharaoh overwhelmed, there were red stains on the sands of Sinai.

Evidences of battle and sudden death a hundred thousand years ago, at er-Rawafi in Sinai, near the boundary of Palestine, were described in a talk given here today by Dr. Henry Field, newly returned from field work with the University of California African Expedition. Dr. Field spoke as guest of Watson Davis, director of Science Service, on Adventures in Science, heard over stations of the Columbia Broadcasting System.

On the sides of a low hill in the desert, members of the expedition found large numbers of primitive hand-axes made of a yellowish-white stone, "in almost mint condition." They were of the type known as Mousterian, which were used by early Old Stone Age men, of the Neandertal level of development.

"As we reconstructed it," Dr. Field related, "the prehistoric flint-knapper and his friends must have been killed by a sudden attack or were driven from this sheltered spot overlooking some water pools, never to return. . . . Hand-to-hand conflict in this part of the world is obviously not merely of our time."

The expedition crossed the Wilderness of Zin, through which Moses led the Israelites after they had escaped from Egyptian bondage. They saw very few signs of life, either ancient or modern, and hardly any animals, until suddenly

they saw a ship—they had arrived at the Suez Canal.

"How the Israelites or anyone else could survive for long in that desert remains a mystery," commented Dr. Field.

Researches on the geography of Sinai convinced members of the expedition that the hosts of Pharaoh pursuing the Children of Israel met their end not in the Red Sea but in a great swamp called the Sea of Reeds.

As Dr. Field reconstructed the event: "Moses and the Israelites were held as slaves at Rameses, later Tanis. Moses felt the approach of a great storm. That evening he led the Israelites eastward across the Sea of Reeds, later called the Reed Sea, and then misinterpreted as the Red Sea in our Bible.

"The Egyptians followed, with their heavy chariots, which became mired. They removed the wheels as described in Exodus, but that did not help. Then the storm broke over the Sea of Reeds. Moses and the Israelites had crossed to dry land. They had escaped. The miracle was complete."

Letters To The Editor

Dear Sir:

Today the May issue of the Digest reached me. When I opened it and saw the photograph on page 5 at the head of the article on Fire-clay entitled "A landscape of about 250,000,000 years ago,—hills, valleys, depressions in Mississippian limestone which were filled by Pennsylvanian fire clay. The clay has been removed by mining. Mexico, Missouri." I said to myself—that IS the picture of the year. Shame on you for not spreading it on at least two pages of your valuable little magazine.

We have many things 250 million years old, and four or five times that old in fossils and rocks. Indeed, many rocks and formations ten times that age, and more, are scattered over the surface of the earth. But to get landscape that has been sealed up by nature and preserved as such to be revealed to us now just as nature put it away in that dim past is nothing short of remarkable. Here is an ancient landscape that is authentic.

I do not wish to imply that there are not other landscapes just as truly remarkable as this one is, for no doubt, some can be found. But congratulations to the editor and the A. P. Green Fire Brick Co., or any one else, responsible for this one.

Yours truly,
Junius J. Hayes,
Pres., Mineralogical
Society of Utah.
University of Utah.
Salt Lake City, Utah

Dear Sir:

. . . Your articles are very good and am pleased with the magazine in general.

Henry Boehm
Prescott, Arizona

ANCIENT BIRD GIANTS RESTORED

Terror Bird, Elephant Bird, Moa Were All Larger Than Ostrich

DR. FRANK THONE
Science Service

Big birds are having their day in American museums just now—birds ten feet tall, birds with leg-bones that rival those of an elephant, birds that could have chopped off your head with one snap of an enormous, trap-like beak—the biggest and most awe-some birds that ever lived.

Fortunately for human peace of mind, they are all extinct. Especially that last number, the night-mare carnivorous monster that once lived in South America, and has been aptly nicknamed the Ter-ror Bird. He is the deadest of the lot, having been extinct something like 11,000,000 years.

More formally, the Terror Bird is known to zoologists as Mesem-briornis. Its massive bones, first found in Argentina nearly 60 years ago, show that it stood nearly as tall as a modern ostrich but was more heavily built. Its great beak, with a tearing hook at the end, indicates plainly that it lived mainly on a diet of flesh.

Like all giant birds, both living and extinct, it could not fly, but pursued its prey on foot. Its habits probably resembled those of that modern American terror-to-snakes, the California road-runner, except that everything was scaled up to size: it could easily have done in a small alligator as its modern smaller counterpart devours a lizard.

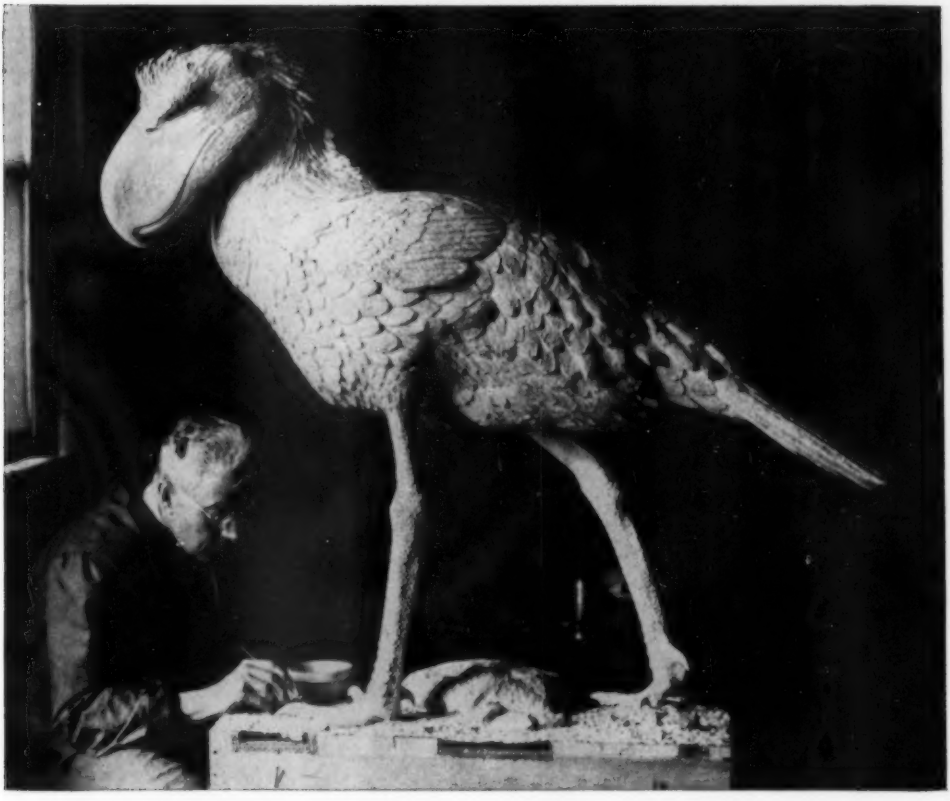
New Restoration Built

The Chicago Natural History Museum has just placed on display a lifelike restoration of this ancient monster - bird, assembled around wooden replicas of its bones and beak. Leon L. Pray, staff taxider-mist, found that carefully saved pencil-sharpener shavings, mixed with casein paint, ground asbestos and chopped tow, made an excel-lent modelling mixture. Feathers were whittled out of balsa wood, and feet and claws from tulip-tree wood. Mr. Pray followed the colora-tion of the Terror-Bird's small-sized collateral descendant, the carima of Argentina and Brazil, in painting his restoration. As you look at it, you are glad that it isn't as alive as it looks—it might decide to snap at you.

Giants From New Zealand

Ten-foot-tall moa skeletons, ap-proximately twice the height of the South American bird though no-where nearly as formidable, were brought back by an expedition from New Zealand just in time to feature the formal opening of the new Sanford Hall of Biology of Birds at the American Museum of Natural History in New York. Moas have not been extinct very long: indeed, there is fair reason to believe that the last specimens were seen by the early Polynesian inhabitants of New Zealand, and perhaps even hunted by them.

The moa was not a bird to be particularly dreaded — unless he happened to kick or step on you. He was fairly closely related to the modern ostrich, and like the ostrich was not a flesh-eater, being con-



Leon L. Pray, staff taxidermist, works on the lifelike restoration of the Terror Bird.

tent with a vegetarian diet varied with chunks of rock and assorted junk.

Five moa eggs have been found. Their original weight is estimated at nearly nine pounds. An egg like that would have fitted into Chestertons' description of Noah: "He ate his eggs with a ladle, from an egg-cup big as a pail."

Original of Sinbad's Roc

At that, however, the moa's egg was only about half the weight of the egg of the great Elephant Bird of Madagascar, which was the biggest bird that ever lived. It has been extinct longer than the moa, but recently enough so that some of its eggshells and a few of its huge bones were known even to the Arab voyagers of the Middle Ages. It was the original of the fabled Roc of the Arabian Nights tales, the bird that could fly off with an elephant clutched in each claw and a third in its beak. (When it came to free-hand fibbing, those Arabs were no slouches!)

Of course the Elephant Bird couldn't fly; it was another giant ostrich, a third taller than present-day ostriches. Its thighbone was half a yard long, and its drumstick bone measured nearly 28 inches. Both were massive in accordance with the body-load they had to carry, so that it is no wonder that this gigantic fowl has been dubbed the Elephant Bird.

Big Weight-Guessing Job

Since it will never be possible to invite any of these extinct bipeds to step on a platform scale, any figures for their once-living weight must be estimates. However, one American Museum ornithologist, Dean Amadon, has done a most ingenious job of estimating the weights of the two huge relatives of the ostrich.

Carefully measuring all important bones of the extinct birds, he has compared them with the corresponding bones of the modern ostrich, as well as with those of the ostrich-like birds of South America and the Australasian region. Comparing measurements of living birds with their known weight and filling in the "unknown" frame in the ratio, he arrives at a weight of nearly half a ton (965 pounds) for the Elephant Bird, and slightly over a quarter of a ton (520 pounds) for the ten-foot moa.

AMERICAN FEDERATION OF MINERALOGICAL SOCIETIES

RICHARD M. PEARL
Colorado College

Richard M. Pearl, President, American Federation of Mineralogical Societies.

The American Federation of Mineralogical Societies begins its second year with promises for the future that seem fully warranted. Its membersip of about 9,000 is distributed among four affiliated regional federations — California, Northwest, Rocky Mountain, and Midwest — comprising over 100 local and statewide clubs. The Federation is incorporated under the laws of Minnesota; its constitution and by-laws are in process of ratification.

The federation now being formed on the Atlantic Coast, and one being encouraged in the provinces of Canada, will make this organization both international and truly American. Additional federations will doubtless be formed in years to come as membership grows and new areas of common interest are discovered within the existing regions.

The first national convention, held in Denver from June 13th through 16th, was an unqualified success. Registrants were present from 45 states. The elaborate show, educational program, and field trips opened a new vista to hundreds of mineral collectors, amateur lapidaries, and geology hobbyists who had not previously known the information and inspiration to be obtained from such an organized activity on a large scale.

The second convention, scheduled for next June, will be held in Sacramento, California, to commemorate the centenary of the 49-ers.

The extensive educational plans of the Federation, initiated by its co-founder and first president, Dr. Ben Hur Wilson, will be further unfolded in the pages of **The Earth Science Digest** during the coming months. Many of these are of special interest to readers of this magazine, which has for its purpose "the advancement of the geological sciences." No aspect of the subject will be overlooked, and the cooperation of every member is earnestly solicited.

1948-1949 Officers, American Federation of Mineralogical Societies.

President: Richard M. Pearl, Colorado Springs, Colorado. (Rocky Mountain Federation of Mineral Societies.)

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PRECIOUS GEMS FROM CHEAPER FORMS OF CARBON BAFFLE SCIENCE

HELEN M. DAVIS
Editor, CHEMISTRY Magazine

Diamond, brilliant gleam on milady's finger and hardest-known biting edge on an oil well drill, may some day be made on a chemical production line.

For diamond, like coal and the graphite which makes up the "lead" in your pencil, consists of carbon atoms arranged in a regular pattern to form a crystal. But in each of these forms of carbon, the crystal pattern is different.

The unsolved riddle of diamond-making is this: How can we crystallize some other form of carbon into the pattern of diamond?

Tremendous Pressure

Dr. P. W. Bridgman, Nobel prize-winning physicist of Harvard University, has evidence that the precious gem can be made by putting very hot graphite under tremendous pressure.

In experiments with a specially fitted industrial press, he has shown the range of pressures which would be required, although his present equipment is not strong enough actually to make diamond.

It might also be possible to attack the problem indirectly. This suggestion comes from Dr. D. P. Mellor, Australian chemist at the University of Sydney.

Certain large organic molecules, made up of hydrogen and carbon alone, already possess some of the structure of diamond. Chemists might be able to join many such molecules together into a much bigger molecule, or polymer, with a structure similar to a diamond crystal. If the hydrogen could then be removed from the polymer, a carbon skeleton built just like the natural gem might be left behind.

It is the structure of the crystal that accounts for the sparkle of the diamond. Light is broken up within the transparent "stone" as it is in raindrops to form the rainbow. It is reflected back and forth by the surfaces within the crystal to give the "fire" so much prized in the jewel.

Everything about the diamond is dramatic and extreme. Its beauty is only the most obvious of its values. This most brilliant and transparent substance is also the hardest material known.

Ice or Fire

But because the discovery of perfect stones is governed by many chances, the possibility of making them artificially under controlled conditions, by ice or fire, offers a tempting field for experiment.

Actually the exciting quest for artificial diamond is by no means a new thing. For nearly three-quarters of a century, men have been trying to make the precious stone in a great many different ways.

More than 65 years ago, J. Ballantine Hannay, a gentleman "of Woodbourne, Helensburgh, and Swordstreet, Glasgow, a Fellow of the Chemical Society of London," described to London's Royal Society how he had made tiny diamonds in his laboratory.

Hannay put a very light metal like lithium or sodium in the bottom of the very strongest wrought iron tube he could find in England. Next, he filled the tube three-

fourths full with light paraffin, a hydrocarbon, and bone oil, a nitrogen-containing chemical, and welded the top of the tube shut.

Then he heated the tube to a dull red heat for several hours in a reverberatory furnace like those used in the iron and steel industry.

In a heartbreaking series of 80 experiments, Hannay obtained the clear crystals only three times. Most of his sealed tubes leaked or exploded, even when he tried making them from steel and cast iron. His furnace was wrecked by the blasts several times, and one of his workmen was badly injured.

Experts at the British Museum agreed that Hannay's few microscopic crystals were just like natural diamonds.

Some of Hannay's later results in other fields disagreed so strongly with well-established work, however, that most scientists lost faith in his laboratory diamonds, too.

Canyon Diablo

The story of the experiments which have generally been accepted as successful in artificial diamond making began more than half a century ago at Canyon Diablo in Arizona where iron from a meteorite was mistaken for a rich deposit of the ore. A sample of this iron was shipped to Philadelphia where a routine effort to cut and polish it ruined an emery wheel. Diamonds, small, black and of little value, were found inside the meteoric iron.

Word of this discovery reached Paris where Henri Moissan had devised an electric furnace for experiments with melting metals.

The French scientist conjectured that the outside of the meteorite had cooled first and the carbon dissolved in the iron had crystallized out in the form of diamonds because the hot inner material would exert pressure inside the cooled and solidified shell. He decided to duplicate the conditions he thought had existed in the meteorite.

Moissan melted iron containing carbon in his furnace, then plunged his white-hot crucible into cold water to cool it. He obtained several kinds of hard substances, one of which was soon put on the market as an abrasive, under the name carborundum.

He also announced that he had produced no less than three kinds of diamonds. This created great interest in scientific circles of more than 50 years ago, and the French scientist in 1896 gave a demonstration of diamond-making in New York.

But alas for the triumphant chemist, more is now known about the fundamental energy requirements of carbon compounds than was known in Moissan's day, and present-day chemists are beginning to wonder whether the small, hard concretions that came from his crucibles were, after all, true diamonds.

New Determinations

At the National Bureau of Standards, in Washington, Dr. Frederick D. Rossini and a staff of associates are conducting a series of determinations of the fundamental properties of carbon. Their experiments indicate that the temperatures and pressures possible to Moissan are extremely unlikely to produce diamonds.

Moissan's supposed success seems to have inspired many people to try their hands at diamond making. A number of claims have been put forward since his time by people who said they had made diamonds. Some of the substances they exhibited, far from having the diamond's adamantine qualities, failed on the most rudimentary tests. Such substances as

Henri Moissan, a 1906 Nobel prize winner, at work at his electric furnace. This photograph was taken over fifty years ago.

sugar and salt have been offered as samples of man-made diamonds, and even naphthalene, with its tell-tale moth-ball odor.

In other cases the products offered were all too genuine, for they were revealed by tests as possessing impurities characteristic of natural diamonds from specific well-known mines.

Moissan's method seems to have been tried in other laboratories, for in 1932 Prof. Ralph McKee at Columbia University stated that he had brought the wrath of the jewelry trade down upon his unsuspecting head by announcing bigger and better diamonds a la Moissan.

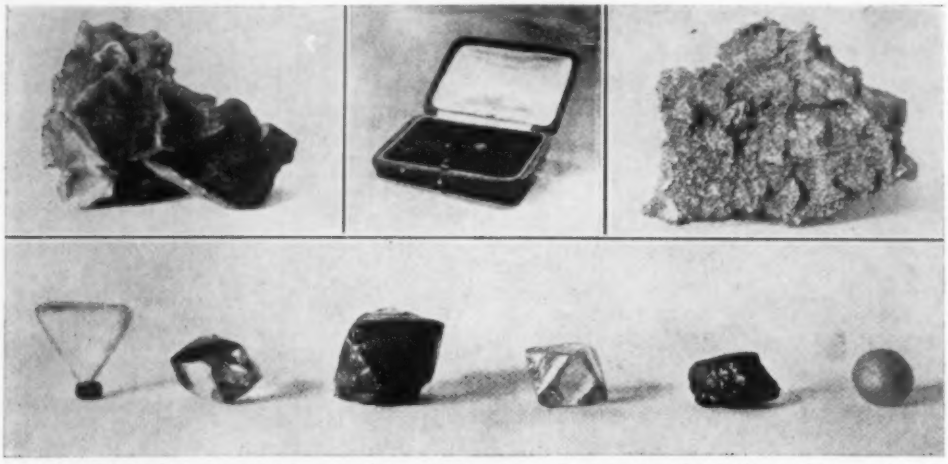
Angry Calls

Angry phone calls poured in: "Purchasers will hesitate to buy when they consider that the price per carat may soon fall, due to artificial production."

Scientists at Columbia had carefully checked the synthetic gems, but here, too, the excitement gradually faded, then died.

Another attempt at diamond-making was launched some eight years ago by Dr. Clifford A. Nickle at the General Electric Company. But very little information about his method was released, and sparklers from G. E. evidently never graced an engagement ring or even a diamond drill.

From all these efforts sprang Dr. Mellor's idea. Even if Hannay's pressures and temperatures were not high enough to change carbon particles into diamond, might they not have made the small paraffin molecules join into a big polymer built like diamond? The lithium metal may then have removed the hydrogen, leaving a carbon skeleton with the crystal structure of diamond.



1. A Kimberley diamond in a matrix of blue clay. 2. Two "artificial diamonds" created by M. Lemoine, a French engineer, in 1907. His diamonds were alleged to be frauds, and he was soon prosecuted by those who had financed him. 3. A block of fused iron covered with graphite. 4. Natural forms of diamond: (From left to right) A Kimberley diamond crystal, a crystal with rounded faces, black diamond (framesite), an octahedron of yellow diamond, carbonado (a black granular form of diamond) from Bahia, Brazil, a white opaque diamond.

Dr. Mellor's conclusion: Chemists should try to make polymers from bigger hydrocarbon molecules, which already have more of the diamond structure than paraffin. Removing the hydrogen from the resulting large molecules might give diamond.

Dr. Bridgman, working along another line of thought, decided that even if Hannay and Moissan had not produced enough pressure to change soft carbon into diamond, perhaps he could do it.

Two-inch Disks

A few years ago, he obtained the backing of three large companies, General Electric, Carborundum and Norton. Soon he was adapting a 1000-ton commercial press to squashing two-inch disks of graphite.

In his apparatus, Dr. Bridgman applied a pressure of over 200,000 pounds a square inch to a graphite disk containing diamond seeds. He found that diamond was changed entirely to graphite. At somewhat higher pressures, the diamond was only partly converted to graphite. And when the pressure was raised to about 425,000 pounds a square inch, the heated diamond didn't change at all.

Dr. Bridgman, now at the limit of strength of his containers, had reached the point of balance between the crystal structures of graphite and diamond. He had shown accurately for the first time that pressure controls this balance. With more powerful pressure, he might have actually tipped the balance and converted graphite into diamond at the point forecast by his data. But his funds were used up, with no prospect of more money to come.

So this chemical puzzle goes still unsolved. But at the end of a synthetic diamond's reflected rainbow may lie someone's pot of gold—and the jewelers' nightmare!

'TWAS BUT SEVENTY-FIVE YEARS AGO!

At the sorting table in the diamond diggings of South Africa, 1872.

On African Diamonds

"Heretofore the only sources from whence diamonds were derived have been limited to two continents, Asia and America; but now in Africa the precious gem has been found. For nearly a century the Indian diamond-fields have yielded but slight returns, barely sufficient to supply the native demand. If it had not been for the Brazilian mines, diamonds

would have commanded such enhanced prices as to have been almost unattainable.

"The African diamond-fields have notably occupied public attention of late, and the question is often asked, what effect this discovery will have on the ruling prices. For a single good stone (and Africa is not exceptional in this respect) hundreds of poor ones are constantly found, and even such stones as give the most flattering promises on their discovery are frequently found after cutting unworthy of the first estimate placed upon them.

"Discarding the fabulous reports in reference to the yield of these mines, it must be kept in view that, if correct, still the question arises in reference to the quality of the stones, as on this point the present and prospective prices of diamonds rest.

"The stones offered from the African mines are in many cases tinged, and even the whitest lack that intense fire, diffused brilliancy, and apparent hardness requisite to satisfy the critical taste of our people."

On the Diamond-Drill

"The diamond-drill, an invention recently introduced, — intended for drilling in mines and quarries, and for general blasting purposes on railroads, canals, etc. — is likely to prove of important value. The greatest depth that has been drilled with this ingenious machine is seven hundred and fifty feet, though it is claimed that it will drill to the depth of one thousand feet as well as ten."

A History Of Fossil Collecting

RICHARD L. CASANOVA

Part 1
The Early Fossil Hunters

Close to the mainland of Anatolia, set in the Aegean Sea, lies the birthplace of paleontology. Set in this emerald sea, lie countless islands known as the Dedocanese. Among these lies the small, almost insignificant isle of Cos. And here, some 2360-odd years ago, Hippocrates, Father of Medicine, found the first fossil in recorded history which has come down to us as an actual specimen.

Some years ago, Dr. Barnum Brown of the American Museum of Natural History, digging about the ruins of the Asklepieon, the famous medical school of the time of Hippocrates, dug up the fragment of a small elephant molar. This molar is believed to be the first fossil, described by one of the ancients, to have been preserved for study by modern man. The fact that Hippocrates found and speculated as to the origin of this fossil, we know from a written study of his.

Hippocrates, however, was not the first of the ancients to collect and study fossils. Many men before him were fossil-hunters, and while the Greeks may have had a word for it, the science of paleontology was unknown to them, while the fossils themselves were not "fossils" by our understanding of the term. The Heroic Age of Greece saw in its science, a mixtur of superstition, arising out of their myths and legends, and natural explanation, brought about through observation and discusssion.

While earthquakes and volcanic eruptions were accepted as acts of Nature as early as 500 B.C., such events were attributed to malicious influence of angry or playful gods.

For not only did the Greeks of yesteryear see volcanoes in action, and observe the results of destructive earthquakes, but they wrote down what they saw, and what they thought about such events. Fortunately for us, other Greeks took brush, quill, or chisel in hand, and copying for all time the history of earth science, before such a term was even thought of. Pliny the Elder was one of these c h r o n i c l e r s of other men's observations and opinions. In his monumental "Natural History," he compiled vast references and notes on plants, animals and minerals. Pliny was a keen student of volcanic action, and many of his own observations were carefully recorded. Unfortunately it was in the further pursuit of scientific knowledge that Pliny lost his life when venturing too close to the scene of the disastrous eruption which destroyed Pompeii in 79 A. D. While Pliny was not a fossil collector, he did list many forms in his works which he considered "inorganic sports" similar to contemporary animals.

Aristotle, Strabo and Seneca reflected upon the geological operations of rivers. They pondered on the effects of rivers upon land masses, the wearing away of shorelines, the desposition of alluvial materials, and even the rise and fall of tides. Fossils came in for their share of attention, for, as

early as 614 B. C., Xenophanes of Colophon wrote briefly on the fossil sea-shells to be found mong the hills and valleys of Malta. He concluded that these shells were left over from some periodical submergence of the land. Others followed in this hypothesis, for Xanthus and Herodotus found fossils and believing them petrified sea-shells concluded that at some time an ancient sea must have spread over northern Africa and the parts of the then known Europe. Strabo was a prolific writer on the geography of his time. He wrote many of the "best sellers" of his day, writings which mention many of his experiences in discovering fossils in the rocks of Egypt. One day, standing in front of the Great Pyramid of Ghiza examining pieces of rock which formed the huge blocks of the tomb, he found numerous fossils. On seeing these nummulites and seeking an explanation, he was told that these were the remnants of the worker's food turned into stone. Strabo rejected this simple explanation, but failed to suggest any other origin for these nummulites. While Strabo was a far more successful geographer than he was a geologist, he joined the philosophers and pseudo-scientists of his age, in claiming in his "Geographie" that at various periods a great portion of the African mainland had been covered over by an ancient sea. And the petrified sea-shells so common were the results of such inundations.

After the decline and fall of the Greek and Roman Empires, such learning as was to survive was to be found in the monasteries and churches of Europe. The "dark ages" were beginning, and with it, the Christian Fathers selected from their libraries manuscript writings which best suited their ecclesiastical philosophies and dogmas. Aristotle was selected as the model of learning, and his teachings and books were to keep the free-study of human antiquity and earth science in churchly bondage. The torch of free-thinking and scientific knowledge, however, was kept alight in a part of the world that was considered a land of heretics. For during Europe's "dark ages," a period of nearly five hundred years, the torch of science was kept burning by the Arabs. By translating and studying the works of Greece and Rome, the Arabs were to preserve the best in philosophy, and such sciences as was made up of medicine, mathematics and astronomy, as was known up till that time. The 10th to 15th centuries was the age of the "Diluvialists," who claimed that animals and plant fossils were the remains of such animals, etc., as perished in the Flood of Noah.

In the 15th century, Leonardo da Vinci in his famous note-books, now translated into English by Edward McCurdy, wrote a chapter on the "Origin and Meaning of Fossils." In his youth, da Vinci planned a navigable canal in northern Italy, and while supervising the work, came upon great number of shell, coral and plant remains. These were being dumped to the sides of the Canal diggings. Studying these petrified remains, he said to himself, "Here are petrified creatures not unlike the existing animals of the sea, and the plants of the field and wood, these being dug from gravel beds which must be of great age. Therefore these rocks and gravels once must have been the beds of ancient seas and valleys, and

these same shells and plants must have inhabited those waters and valleys." Thus theorizing that the fossils found in the mountains of Italy were not deposited there during the Deluge, he went on to suppose that they came to rest within their strata at a time when seas covered he mountain tops. He further thought that with the lowering of the seas, the muds changed into stone, and the shells becoming filled likewise with mud, turned into stone also. In part he stated "These are still to be found in many places, and almost all the petrified shell fish in the rocks of the mountains still have their natural frame round them, and especially those which were of a sufficient age to be preserved by reason of their hardness, while the younger ones which were already in great part changed into chalk were penetrated by the viscous and petrifying moisture." He demanded that the alluvialists explain how fossils could be produced in such shapes, sizes, of so many species and of so many obviously different ages, though "sports of nature."

Fracastoro, another Italian, who lived from 1483 to 1553, was a physician at Verona. He too collected fossil-shells, and in his study of them, maintained that fossil-shells were considerably older than the Deluge of Noah. For the Deluge being of shorter duration would have scattered the fossils over the surface of the earth, rather than burying them deep within the strata which composed the quarries and mines deep in the mountains. He went on to demonstrate that fossils were once living animals; and regarded as completely absurd the theory of fossils being formed by "plastic forces."

The 16th century was to see the divorce of science from the ecclesiastical bondage of Churchly dogma. And with the coming of a new century, there came upon the scene a host of fossil hunters. Aided in their efforts to spread their knowledge and thinking by the printing press, they were to push aside the barriers of a Church theology that stated that the "land and sea were separated on the third day of creations, while animal life appeared on the fifth day." Eince the days of Aviccena, for an observer to be branded as a heretic, all he had to do was declare his opinions against the teachings of Aristotle and Churchly doctrine. To escape prosecution, men who studied fossils stated that such animal evidence was formed by plastic forces deep within the earth, which formed such "lusus naturae," in imitation of true organisms, but in reality being mineral concretions and the so-called "sports of nature," the latter being a phrase that was to linger in history till the 19th century.

To Be Continued

Recommended Reading

The Earth Science Digest has selected the following articles from current periodicals as recommended reading.

ECONOMIC GEOLOGY

"Growing Jewels by the Mile". Frederick H. Pough. *Science Illustrated*, Vol. 3, No. 7 (July 1948), 49-51, 56.

"Spitzbergen Mines Coal Again". *The National Geographic Magazine*, Vol. 94, No. 1 (July 1948), 113-120.

PHYSICAL GEOLOGY

"Pleistocene of the Great Plains". E. H. Colbert, Richard Foster Flint, Paul O. McGrew, C. Bertrand Schultz, Thompson M. Stout, A. B. Leonard, Claude W. Hibbard, John C. Frye, Wallace W. Atwood, Wallace W. Atwood, Jr., Maxim K. Elias, E. C. Reed, Glen L. Evans. *Bulletin of the Geological Society of America*, Vol. 59, No. 6, (June 1948), 541-630.

FIND IRON AGE MAN'S 'OLD LOOK' TWO COATS — AND NO PANTS AT ALL

Science Service

Men's fashions in Denmark 1900 years ago did not run to two-pants suits. They called for two coats—and not pants at all.

Such is the indication of two bundled-up garments found with the nude corpse of a man, well preserved in the acid water of a Danish peat bog some time ago. At first taken for blankets, they proved upon careful unwrapping and cleaning to be two skin jackets.

The better one of the two was made from 22 skins of some short-haired animal, so skillfully sewed with fine skin thread that any present-day furrier might be proud to claim it as his handiwork.

Wooden Plugs

It is about 35 inches long in front but shorter in the back, with a 21-inch neckband. One side has two buttonholes, and the opposite edge is equipped with two leather straps sewed around a pair of small wooden plugs. One of these was found crosswise in its buttonhole.

The second garment is in much poorer condition. It is about the same size as the other, but of "pullover" pattern. The material is sheepskin.

By a series of pollen tests, Dr. Alfred Andersen, leading Danish geologist, fixed the date of the find as of the Iron Age, about the beginning of the Christian era.

Ancient Carving

An ancient carving in the castle built by the Romans at Mainz, Germany, furnishes corroboration of this two-coats, no-pants fashion of that date. It shows chained Teutonic war prisoners wearing nothing but these short jackets.

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